RELATION OF THE SOIL COLLOIDS TO THE CONDUCTIVITY OF THE SOIL.

By T. B. FRANKLIN.

[Abstract reprinted from Nature, Mar. 10, 1921, p. 62.]

Soil conductivity can be measured qualitatively by the value R_4/R_0 where R_4 and R_0 are the temperature ranges at the 4-inch depth and at the surface. The effects of weather changes—rain, snow, frost, surface mulch, evaporation, water content, and period—on R_4/R_0 have been discussed in a previous paper, and if these changes are all eliminated a constant value for the ratio should be obtained in any soil. Experiments with sand and clay loam showed that this constant value was obtained in sand, but not in clay loam; in the latter soil it varies with changes of the mean soil temperature. Thus when all other weather changes had been eliminated, but the mean soil temperature varied between 10° C. and 22° C., R_4/R_0 for sand lay between 0.50 and 0.52, while for clay loam it lay between 0.37 and 0.45. Moreover, ignited clay loam behaved exactly like sand, showing that the cause of the variation was destroyed by ignition. It is suggested that the colloidal clay is the cause of this temperature coefficient of conductivity in clay soil.

SUNLIGHT ENGINEERING.

The following is a brief abstract of a paper written by Mr. H. L. Seymour, entitled "Sunlight Engineering; Its Relation to Housing and Town Planning," and published in the "Journal of the Royal Astronomical Society of Canada," May, 1920:

Just as the astronomer feels certain that there are many bodies which he has not yet seen, so is it with the bacteriologist in his work. Every contagious and infectious disease is carried, as a rule, by a specific bacterium or similar organism. Now, the oxidizing action of direct sunlight and its accompanying drying properties are the greatest natural agencies in destroying disease or pathogenic bacteria. This is the strongest scientific argument that can be advanced, as far as housing is concerned, for direct sunlight. In a cubic meter of air taken from over the ocean there was found only one bacterium. In the same amount of air taken from a Paris hospital there were 79,000 bacteria. In the open air of the country there are fewer bacteria than in city air, which, as a rule, is shut off from direct sunlight.

Skylight comes from all directions of the heavens; sunlight from only one direction, constantly varying with the revolution of the sphere.

Second only to air is light and sunshine essential for growth and health. Sunshine is one of nature's most powerful assistants in enabling the body to throw off those conditions which we call disease. Not only daylight but direct sunlight is required; indeed, fresh air must be sun-warmed, sun-penetrated air. The sunshine of even a December day has been recently shown to kill the spores of the anthrax bacillus. This is no mean performance when one considers that bacterial spores or "seeds" are protected with a hard casing which renders them much more difficult to destroy than the parent bacteria. The following figures give the duration of life of the tubercle bacillus under various conditions:

In dark places	2 to 18 months.
Under diffuse daylight	6 to 24 hours.
In direct sunlight	10 minutes to 1 hour.

Besides being nature's great preventive from the spread of disease, the exhilarating effects of sunshine are recognized by everyone, and its beneficent effect upon public health and sanitation is well known.

In winter the intensity as well as the duration of sunlight is less than that of summer. City planning, as far as sunlight is concerned, is therefore the problem which most concerns the four months, October 21 to February 21, in the Northern Hemisphere. If ample sunlight can be provided during these four months the problems are with few exceptions solved.

Concerning the orientation of detached buildings:

(1) Isolated detached buildings should be constructed with their walls not square with the cardinal points of the compass, but at an angle therewith, preferably 45°.

(2) Detached buildings as usually grouped in rural and residential districts should be oriented as in (1) the streets on which they face running NE.–SW. and SE.–NW.

Concerning attached buildings:

(1) Long, narrow blocks with high buildings should have their lengths on streets running N.–S., as this condition is suited to intensive city development.

(2) Square blocks, with low, attached buildings, should usually be oriented so that streets make an angle of 45° with the cardinal points.

(3) Houses fronting on E. and W. streets should, if possible, be detached.

Heights of buildings should have some relation to the width between buildings and width of streets.—*A. H. Palmer.*

DISCUSSION.

In connection with the above, attention is invited to a paper by the undersigned on "Variations in the total and luminous solar radiation with geographical position in the United States," in the MONTHLY WEATHER REVIEW, November, 1919, **47**:769–793, and especially to pages 790–791.

In a table is given the possible duration of sunshine, at different latitudes and different seasons of the year, for vertical surfaces (1) square with the cardinal points of the compass and (2) at an angle of 45° therewith, and diagrams show the illumination intensity thereon in foot-candles. The advantage of orienting detached buildings and laying out city streets in accordance with (2) is pointed out. Within the limits of the United States each side of a building, and all streets, oriented in this way, may receive direct solar radiation for at least a short time on every day of the year; and in summer both the duration and the intensity upon the four sides of a building are fairly equable.—*H. H. Kimball.*

551.52: 551.576

ON THE RELATION BETWEEN THE NIGHTLY OUTGOING HEAT RADIATION, AND THE AMOUNT AND KIND OF CLOUDS.[1]

REVIEW.

The author calls attention to the paucity of data bearing upon the above relations and to their importance in obtaining a clear conception of the heat economy of the earth and of the balance between incoming and outgoing radiation. In the absence of a detailed treatment of the

[1] Asklöf, Sten. Über den Zusammenhang zwichen der nächtlichen Wärmeausstrahlung, der Bewölkung und der Wolkenart. Geografiska Annaler 1920, H. 3.

subject the results of measurements made by the author during the months March–June, 1918, at the Meteorological Institute in Upsala, Sweden, are presented. The measurements were made with an Ångström pyrgeometer installed on the roof of the instrument house of the institute, and care was taken to keep the metal strips of the instrument oriented parallel to the direction of the wind.

Ångström [2] had already given the following equation for the relation between the cloudiness m and the effective outgoing radiation R_m:

$$R_m = (1 - km) R_0$$

in which R_0 is the actual outward radiation with a cloudless sky. Ångström found from measurements made in California and Algeria that the value of R_0 may be computed from the equation

$$R_0 = \frac{T^4}{293^4}(A + B \cdot 10^{-\gamma p})$$

in which T is the absolute temperature and p is the vapor pressure. He also found the following values for the constants of the equation:

$A = +0.439$; $B = -0.159$; $\gamma = 0.069$; but Asklöf found for A and B the values $+0.126$ and $+0.179$, respectively.

In estimating the cloudiness, m, account must be taken of the thickness of the cloud layer as well as of the kind of clouds. This is done in Sweden and in some other European countries in connection with the regular cloud observations.

For the value of k Ångström gave 0.09, but Asklöf found, for lower clouds only, that 0.083 is a better value. Evidently k must have a different value for different kinds of clouds, as is indicated by the following table, showing the relation between clouds at different levels and the outward radiation:

Clouds.		Number of observations.	Actual outgoing radiation.
Amount.	Kind.		
10	St., Nb., St. Cu	10	0.023
10	A. St.	2	0.039
10	Ci. St	5	0.135
0		28	0.169

In a table are given values of R_0 measured on cloudless nights, and of R_m measured on nights when clouds were present. Also, R_0 for both clear and cloudy nights, computed from the equation

$$R_0 = \frac{T^4}{293^4}(0.126 + 0.179. \quad 10^{-0.069p}) \tag{1}$$

and values of R_m for nights when lower clouds were present obtained by substituting the value of R_0, computed as above for the respective nights, in the equation

$$R_m = (1 - 0.083m) R_0 \tag{2}$$

Not very close agreement can be expected between the observed and computed values of R_m, for the reason that on clear nights the difference between the observed and computed values of R_0 shows a maximum of about ± 15 per cent. Furthermore, at night there is great difficulty in estimating the value of m.

[2] Ångström, A., On the radiation and temperature of snow, and the convection of the air at its surface. Arkiv. för mat., astr. och fys., Bd. 13, No. 21, S. 13-14.

If we substitute in equation (2) the measured value of R_m on a night when lower clouds were observed, and the corresponding computed value of R_0, the equation may be solved for m, and the value obtained will probably be a better measure of the cloud density than the observed m. Such computed values of m are included in the table above referred to. In general, they do not differ from the observed (estimated) value by more than 1 on a scale of 10 for complete cloudiness. It is noticeable that the maximum differences (observed $m=5$, computed $m=8$, and observed $m=4$, computed $m=2$) occur with a partly overcast sky.

It is of interest to compare the above results with measurements made under the direction of the reviewer at Mount Weather, Va., during the months May–September, 1914; in Washington during the months December, 1914–April, 1915; in North Carolina during May, 1915; and published in this REVIEW for February, 1918, **46**: 57–70. The following table summarizes actual radiation measurements with a clear sky, or with lower clouds present.

Clouds.		Number of observation.	Measured outgoing radiation.
Amount.	Kind.		
10	St., St. Cu	18	0.044
8-9	St. Cu	10	0.068
5-7	St. Cu	9	0.078
3-4	St. Cu	3	0.126
1-2	St., Cu., St. Cu	5	0.131
0		121	0.160

The above amounts of cloudiness do not take into account the density of the cloud layer, and probably give too much weight to clouds near the horizon.

In measurements of outgoing radiation with the sky completely overcast it must be recognized that the cloud layer may have a higher temperature than the surface air temperature. Such a case is noted in the REVIEW above quoted, page 65. However, in general, it seems evident that nocturnal radiation measurements may be useful in indicating the thickness of the overlying cloud layer, as well as in furnishing data relative to the heat balance between incoming and outgoing radiation.—*H. H. Kimball.*

551.5 : 634

FACTORS CONTROLLING DISTRIBUTION OF FOREST TYPES.

By G. A. PEARSON, Forest Examiner.

[Reprinted from *Scientific American Monthly*, New York, March, 1921, p. 270.]

Mr. G. A. Pearson, forest examiner of the Fort Valley Forest Experiment Station, presents in two extensive papers published in Ecology for July and October, 1920, an account of his investigations on Factors Controlling Distribution of Forest Types. The following is a summary of Mr. Pearson's results and conclusions:

1. Air temperature in the San Francisco mountain region decreases rather uniformly with a rise in altitude, excepting for local inversions in the minimum, which occur between the yellow pine and the Douglas fir types, due to air drainage. The lowest absolute minima and the shortest frostless season occur in the yellow pine type, following closely by the alpine type. The highest temperatures and greatest duration of high temperatures are found in the lowest altitudes. Maximum temperatures decrease uniformly from the lowest to the highest stations. The daily range is greatest in the lower altitudes, decreasing from about 50° F. in the pinon-juniper to about 20° F. in the Engelmann spruce. From the